DOCUMENT RESUME

ED 076 903 CG 007 998

AUTHOR Deci, Edward L.

TITLE Intrinsic Motivation.
INSTITUTION Rochester Univ., N. Y. Management Research Center.
PUB DATE Mar 73
NOTE 57p.

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS Behavior; Behavior Development; *Behavior Theories; *Individual Psychology; *Motivation; Motivation Techniques; Needs; *Research Reviews (Publications); Research Utilization; *Self Actualization; Self Concept
IDENTIFIERS Intrinsic Motivation

ABSTRACT

The paper draws together a wide variety of research which relates to the topic of intrinsic motivation; intrinsically motivated activities are defined as those which a person does for no apparent reward except the activity itself or the feelings which result from the activity. Most of this research was not originally reported within the framework for intrinsic motivation, but the paper reinterprets the work within that framework. Several approaches which may account for intrinsically motivated behavior are considered: (1) drive naming; (2) optimal incongruity and optimal arousal; (3) reduction of uncertainty; and (4) competence and self-determination. The paper discusses, compares, and to some extent integrates these four approaches. The report is a first step in bringing together the laboratory work in the basics of intrinsic motivation with the industrial efforts to design jobs so that they contain potential for greater intrinsic motivation for the job holder. Extensive references are included. (Author/SES)

ED 076903

CG

Graduate School of Management

Management Research Center

University
of
Rochester

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION
THIS DOCUMENT HAS BEEN REPRO
DUCED EXACTLY AS RECEIVED FROM
THE PERSON OR ORGANIZATION ORIGIN
ATING IT. POINTS OF VIEW OR OPINIONS
STATED DO NOT NECESSARILY REPRE
SENT OFFICIAL NATIONAL INSTITUTE OF
EDUCATION POSITION OR POLICY

SG 007 998

FILMED FROM BEST AVAILABLE COPY

ED 076903

Technical Report 62

Intrinsic Motivation

Edward L. Deci
Management Research Center
University of Rochester

This research was sponsored by the Personnel and Training Research Programs, Psychological Sciences Division, Office of Naval Research, under Contract No. N00014-67-A-0398-0015, NR 151-351.

Approved for public release, distribution unlimited. Reproduction in whole or in part is permitted for any purpose of the United States Government.

March, 1973

FOREWORD

A main purpose underlying the current program of ONR-supported research was to bring together the laboratory work in the basics of intrinsic motivation with the industrial efforts to design jobs so that they contained potential for greater intrinsic motivation in whoever was expected to occupy the jobs.

A first step then required drawing together what is known about intrinsic motivation. The present report is an effort to provide this review. Much of the thinking on it was incorporated in the initial conceptualization of the dimensions likely to be of consequence in surveys of the elements of job design which will be presented in subsequent reports.

Two approaches to understanding intrinsic motivation are particularly relevant for job design. The first is the concept of optimal stimulation. People seem to need an optimal level of stimulation; too much or too little is aversive and they will behave so as to move toward the optimum. People need jobs that provide the optimal challenge. And this optimum will be different for different people.

The concepts of competence and self-determination are also useful in understanding job design. People need to feel competent and this seems to happen when they have an opportunity to use their creativity and resourcefulness. They need to be challenged. Yet too much challenges will result in failure, and research indicates that failure decreases intrinsic motivation. The need for feelings of self-determination also has implication for job design. People need to have some say about what they do and how they do it. Designing jobs with flexibility and participation in making relevant decisions is important for eliciting intrinsic motivation.

Bernard M. Bass
Principal Investigator

March 23, 1973

Whenever I observe a child, I am amazed and delighted by his inquisitiveness. He picks things up, smells them, tastes them, feels them and keeps asking, "What's this?" He seems to have an insatiable curiosity. Aristotle (980) recognized this when he stated, "All men by nature desire to know." He was, in essence, postulating an intrinsic motivation to learn, which has now been clearly documented.

Many activities seem to be intrinsically motivated. People spend large amounts of time solving puzzles, painting pictures and doing other play activities. They also seem to be intrinsically motivated to do challenging work which requires creativity and resourcefulness. The primary reward for these activities seems to be the activity itself or the feelings which result from the activity. In otherwords, the rewards are mediated within the individual. He does the activity not because it will lead him to an external reward (like money, praise, food, etc.) but rather he does it because the activity is rewarding in its own right.

Few psychologists have recognized the concept of intrinsic motivation. Indeed, many behaviorists have refused even to recognize the concept of motivation. Koch (1956, 1961) was one the first psychologists to make a strong assertion that motivational theory needs to be revamped to give considerable importance to the notion of intrinsic motivation. He suggested that when a person engages in an intrinsically motivated activity he becomes fully absorbed in the activity and committed to it. When a person is intrinsically motivated, he can tolerate substantial fatigue and suppress primary drives such as hunger. According to

Koch (1956) intrinsically motivated behavior is highly organized, energized and motivated behavior; thus, it should be recognized by psychologists and incorporated into their theories.

Koch's paper (1956) was an extremely important one in that it called attention to the need for giving considerable thought to the notion of intrinsic motivation, yet it did not deal with the possible psychological or physiological processes which are involved in intrinsic motivation. This paper will deal with those issues by reviewing the research and theory on intrinsic motivation. The area is a new one, and has received very little attention from psychologists, although as we will see, it has its roots in work which spans the last half century.

Woodworth (1918) began to develop ideas which provided the basis for his behavior--primacy theory (1958) which is his account of intrinsically motivated behavior. He reported that behavior can provide its own drive in the following manner (c.f. Woodworth, 1918). There are general motives such as curiosity, self-assertion, and constructiveness, which provide the energy for specific mechanisms or abilities to behave so as to satisfy these general motives. The specific mechanisms derive from innate capacities--what Woodworth called "native equipment," though of course they can be modified by learning. A person who dances particularly well may be motivated by general motives such as self-assertion and constructiveness, but the direction in which energy from these motives is directed would be due to good mechanisms for dancing.

Humans, Woodworth proposed, are active organisms. He stated, "... it may at least be said to be part of the native equipment to be

active in a motor way, as well, indeed, as in the way of exploration." (Woodworth, 1918, p. 50) This tendency toward activity is manifest especially clearly when an activity is running by its own drive (i.e. Woodworth proposed that an activity can be initiated by an extrinsic motive but that, "... only when it is running by its own drive... can [it] run freely and effectively..." (1918, p. 70).

This notion, that an activity regardless of its initiating motive can become intrinsically interesting was given the name functional autonomy by Allport (1937).

Woodworth's early work placed great emphasis on instincts and derived in part from the writing of McDougall (1908). This is a much different framework from that taken by psychologists who have written about intrinsic motivation more recently. Further, Woodworth did not discuss the psychological or physiological basis of intrinsic motivation. Nonetheless, he did postulate intrinsic motivation and set the stage for later work in the area. His notion that activities provide their own drive was an important initial contribution, though the strong emphasis on behaviorism which was beginning around the time of Woodworth's writing probably kept other psychologist's from pursuing this important line of inquiry.

Exploration and Manipulation: Drive Theory Accounts

In the thirty year period following Woodworth's early writing there was virtually no attention paid to the concept of intrinsic motivation. However there were a few animal studies which documented that exploration

is a reinforcing activity. Dashiell (1925) and Nissen (1930) reported that rats will cross an electrified grid and endure shock in order to be able to explore novel stimuli in a maze. This showed not only that exploration is an intrinsically rewarding activity, but that the opportunity to explore also reinforces other responses.

In the late 1940's and early 1950's a great deal of work was reported which further documented that manipulation and exploration are important examples of intirnsically motivated behavior.

Berlyne (1950, 1955) has demonstrated that rats are quick to explore novel spaces and objects and that they persist at this exploration so long as novel stimulation is available. Welker (1956a, 1956b) has found similar results for chimpanzees. When the experimenter placed a novel object in the chimpanzees' presence, they readily explored it and once they had explored it and manipulated it, they appeared to lose interest. These experiments showed quite clearly that animals are motivated to explore and manipulate novel stimuli.

Montgomery (1952, 1953, 1954, 1955; Montgomery and Segall, 1955) also demonstrated that rats spontaneously explore novel places and that the opportunity to explore these places reinforces responses which afford that opportunity. He suggested that novel stimuli elicit an exploratory drive, but they also elicit a fear drive which may block exploratory behavior if that drive is of sufficient magnitude. Glanzer (1953, 1958) took a similar position.

Butler (1953, 1954, 1957, 1958; Butler and Harlow, 1957) has reported that visual exploration of novel stimuli is rewarding for monkeys and that the probability of such a response increases as the interval between

successive opportunities to explore increases. These findings are quite compatible with those of Montogmery. Exploration was seen as an intrinsically rewarding activity which could be used to strenghten other responses. When an animal had been deprived of the opportunity to explore, exploration became even more rewarding. Butler accounted for his findings by positing a "motive toward visual exploration of the environment" while Montgomery suggested an exploratory drive.

Myers and Miller (1954) and Zimbardo and Miller (1958) report results supporting those of Montgomery and Butler, although these investigators suggested that animals explore novel stimuli in order to relieve a "boredom drive" which results from unchanging stimuli. This drive explanation focused on the boredom which results from insufficient stimulation, whereas Montgomery's drive explanation focused on the elicitation of an exploratory drive by a novel stimulus.

Isaac (1962) also suggested a boredom-drive explanation for curiosity and exploratory behaviors. The absence of stimulation or presence of unchanging stimuli increases boredom so that novel stimuli perceived through any sense modality becomes more reinforcing. Isaac (1962) reported an experiment which suggests that the absense of stimulation produces greater boredom than the presence of an unchanging stimulus to one of the sensory modalities. Therefore, monkeys who had been deprived of sound and light engaged in more behavior to turn on a light than those who had been deprived of light but were given an unchanging sound.

The importance of novel stimulation has also been documented in humans by the well-known stimulus deprivation studies (Bexton, Heron,

and Scott, 1954; Heron, Doane, and Scott, 1956). These studies found that humans are generally unwilling to tolerate more than three or four days of constant stimuli even though they received substantial monetary payments for doing so.

Jones (1961) and Jones, Wilkinson, and Braden (1961) demonstrated a similar finding. Information deprivation was shown to have strong motivating properties which the authors interpreted in terms of Hullian drive theory (cf. Hull, 1943).

The drive naming approach to explaining intrinsically motivated behavior has also been used by Harlow in the realm of manipulative behavior. Harlow and his associates (1950, 1953a, 1953b; Harlow, Harlow and Meyer, 1950; Gately, 1950; Davis, Settlage and Harlow, 1950) have shown repeatedly that manipulating a complex mechanical puzzle (i.e. a series of hasps, hooks and hinges) is intrinsically rewarding and can be used to strengthen various other responses. Harlow has posited a "manipulation drive" to account for these findings, which is very similar to Montogmery's notion of an exploratory drive.

Premack (1959, 1962, 1963) has also demonstrated the reinforcing potential of manipulatory responses with children and monkeys. For example, in one experiment (Premack, 1962) the opportunity to run in an activity wheel was used to strengthen other responses in monkeys.

In sum, a plethora of data supports the notion that curiosity, manipulation, and exploration are intrinsically motivated behaviors. Organisms seem to need a certain amount of novel stimulation to function effectively, and the opportunity for novel stimulation (e.g. manipulating an object or exploring a new area) has frequently been used to reinforce other responses.

The most common approach to explain these phenomena during the 1950's was that of drive naming. Animals were believed to have an exploratory drive (Montgomery, 1954), a drive to avoid boredom (Myers and Miller, 1954) a manipulation drive (Harlow, 1953a), a sensory drive (Isaac, 1962), or a drive for visual exploration (Butler, 1953).

Hendrick (1942, 1943) suggested that humans possess an instinct to master, which is an innate drive. As such, his notion, is essentially one more example of drive naming, though he uses the term instinct instead of drive.

The drive naming approach has been criticized by many writers. Hunt (1965, 1971a) suggested that drive-naming seems to be "a revisitation of the instinct naming of McDougall (1908)," (Hunt, 1971a, p. 6). He suggested further that this approach may hinder the chances of a real understanding of these phenoma.

White (1959) made a rather detailed criticism of the drive naming approach. If exploration is to be considered a drive, it would have to have the same functional properties as the established drives such as hunger, thirst and sex. First, White (1959) pointed out that according to this traditional view, (1) drives involve a deficit or need in body tissues outside the nervous system which provide a strong and persisting stimulus to the central nervous system which (2) energizes behavior that results in a consumatory response which reduces the need or deficit and (3) produces learning.

White then explained that the exploratory "drive" does not fit this definition. It does not seem to be correlated with any non-nervous

system tissue deficit, so no tissue need can provide the stimulus for behavior. White suggests that even if one broadens the term drive to include a general drive in the reticular activating system which is responsive to sensory stimulation, it does not satisfy the condition of being a strong and persistant stimulus to initiate and sustain activity.

Furthermore, White noted that there is no comsumatory response involved with exploration as there is with hunger and other primary drives. It is true of course that the exploration of a particular area can become satiated (Berlyne, 1950; Welker, 1956); however this is not the same as a consumatory response.

Finally, the reinforcement by exploratory behavior does not seem to involve any need reduction. White used the work of Montgomery (1954) to show that animals often make choices which increase rather than decrease the "exploratory drive." If the exploratory drive is instigated by a novel stimulus as Montgomery and others suggest, then one would expect that animals should avoid novel stimuli since the novel stimuli increase the drive instead of reducing it. Yet, just the opposite is true; animals seek out stimuli which would, by the drive account, increase the exploratory drive. Using a drive explanation, one must infer that animals are drive inducers as well as drive reducers.

Consider now the possibility that exploration is instigated by the boredom drive as suggested by Myers and Miller (1954) or Isaac (1962). If boredome causes exploration, then the reinforcement for exploratory behavior is what returns the animal to a state of boredom. With eating,

the end state is a full stomach and the reduction of hunger, whereas with exploration, the end state is a return to inactivity and boredom. White stated, "It is distinctly implausible to connect reinforcement with the wanning of an agreeable interest in the environment or with a general progress from zestful alertness to boredom," (1959, p. 302).

In sum, if one were to consider exploration, manipulation etc. a primary drive, one would have to redefine drive such that it does not require (1) tissue needs or deficits, which (2) provide a persistent stimulus to initiate consummatory behavior, and (3) reinforce the behavior through the reduction of the drive.

It is clear then from the above analysis that drive naming as an approach to understanding intrinsic motivation is inadequate. There have, however, been attempts by other behaviorists to account for exploration, manipulation, and curiosity within a drive theory framework. There are two possible approaches which White (1959) considers for doing this, secondary reinforcement and reduction of anxiety.

A secondary reinforcement position (cf. Keller, 1971) would hold that through the pairing of exploratory and manipulatory behaviors with primary drive reduction, those behaviors acquired reinforcing properties. For example, if an infant engaged in exploration at the same time he was being nursed, the exploration by itself would eventually become a reinforcer. To retain its reinforcing value, it is necessary that the behavior occur periodically in the presence of primary drive reduction. Without this occasional re-pairing, the secondary reinforcer will lose its ability to reinforce.

In the Butler (1953) experiment mentioned above monkeys learned discriminations by being reinforced with the opportunity to engage in visual exploration. Butler reported that these responses showed remarkable resistance to extinction--a fact which is difficult to reconcile with a secondary reinforcement position. White explained that since reinforcement of primary drives did not occur in the experimental situation, secondary reinforcement should not prevent extinction. Both White (1959) and Berlyne (1966) argued that the acceptance of a secondary reinforcement explanation would require the assumption that exploration had often been paired with the reduction of primary needs such as hunger. This assumption is quite implausible since avid exploration occurs in neonates very shortly after birth, and it seems unreasonable to assume that this could have developed so quickly and strongly through the process of secondary reinforcement.

Finally, White explored the use of anxiety reduction as a explanation of exploration. To accept this explanation, one would have to accept that novel stimuli arouse anxiety and that the exploration of these reduces it. But surely if novelty induces anxiety, avoidance would be a more probable anxiety reducer than exploration would. Yet animals often seem eager to confront and explore the stimuli which would, according to this approach, be anxiety producing.

In sum, White (1959) and Berlyne (1966) have agrued quite convincingly that a drive explanation of exploratory and manipulative behaviors is indeed suspect. Fowler (1965, 1967) however, asserted that drive theory can be modified to account for "intrinsic" behaviors by utilizing the concept of optimal arousal.

Optimal Incongruity and Optimal Arousal

The approach to conceptualizing intrinsic motivation which has received the most attention in the last two decades has discrepancy or incongruity as its central notion. Hunt (1963, 1965, 1971a, 1971b) has been the strongest spokesman for this point of view. Much of the work related to incongruity was not presented by the original authors within a framework of intrinsic motivation; however, Hunt has brought this work together within that framework, and some of the discussion of incongruity which follows will be patterned after Hunt.

The central issue for most of the work in this area is to what extent people will approach or avoid incongruous (or dissonant or discrepant) inputs (or cognitions).

Some writers maintain that people are motivated to reduce incongruity or dissonance between stimuli. Festinger's well-known cognitive dissonance theory (1957) asserted that two dissonant cognitions produce an aversive state which motivates people to behave in such a way as to reduce the dissonance and avoid situations which would produce further dissonance.

Festinger (1957) did not relate his theory to an "incongruity" interpretation of intrinsic motivation; however, doing so would lead to the following. Intrinsically motivated behaviors would be behaviors which are motivated by the need to reduce dissonant cognitions. Festinger posulates that all dissonant cognitions produce discomfort and energize behavior to reduce the dissonance.

There is an enormous amount of support for Festinger's notion that cognitive dissonance is a motivating force, although most of that support is within the realm of attitude change. There is also a substantial number of studies which support the notion that in certain situations intrinsic motivation for an activity will be enhanced as a means of reducing dissonance (Aronson, 1965). It is clear that people often behave to reduce dissonance; however, it is not clear that all dissonance is aversive. In fact people often behave in ways which they know will produce dissonance.

Hebb (1946b), in a paper which expands on his earlier theory of emotion (Hebb, 1946a) and on reports of experimental work (Hebb and Riesen, 1943; Hebb, 1945), presented evidence that stimuli which were discrepant from the expectations of chimpanzees produced fear and avoidance behaviors. Fears caused by novel stimuli were spontaneous and did not result from pairing with other primary fear inducers. Rather, they appeared to result from the interruption of cerebral organization by incongruous stimuli. This can also account for fear induced by under stimulation situations such as children in dark rooms. Children typically develop cerebral organization from afferent inputs of visual stimulation during waking hours. Dark rooms are incongruous with the cerebral organization and therefore fear arousing.

From this important paper (Hebb, 1946b) one might infer that incongruity between input and cerebral organization is always aversive. This view would support Festinger's position, yet Hebb probably did not mean to imply this. In later work (e.g., Hebb, 1949; Hebb and Thompson, 1954) he suggested that in certain situation incongruity is pleasurable.

Further, the proposition that all incongruity or dissonance is aversive is difficult to reconcile with the plethora of studies mentioned above which show quite clearly that novel stimulation (i.e. incongruity) is rewarding and prodeces approach behaviors. This impiies of course that Festinger's postulation that dissonance is always aversive is an overstatement. Although people often behavė so as to reduce and avoid dissonance or incongruity, it is clear that they often behave so as to induce and approach dissonance or incongruity.

In an attempt to account for this seemingly discrepant data, Hunt (1965) presented a theory which centered around the notion of an optimal level of incongruity. This notion, or a similar one, has appeared also in the work of McClelland, Atkinson, Clark, and Lowell (1953), Hebb (1955), Leuba (1955), Dember and Earl (1957), Fiske and Maddi (1961) and Berlyne (1967, 1969).

McClelland et. al. (1953) were concerned with an optimal incongruity between some aspect of a perception and the adaptation level (cf. Helson, 1964) for that particular aspect. For example, a person at any given time has developed an adaptation level and therefore, that amount of the stimulus will cause a neutral response. Small deviations from that amount--either above or below that amount--are desired and cause an affectively positive response. Large discripancies cause negative affect. Haber (1958) has presented evidence in support of this position using human subjects who immersed their hands in water of varying temperatures above and below their adaptation level.

The McClelland et. al. theory of motivation is an affective arousal theory. A discrepancy between perception and adaptation level, they clarimed, causes a primary emotional response. Cues which have been paired with that affective state become capable of redintegrating that state, and the redintegration of an affective state is precisely their definition of motivation.

The discrepancy between an input and an adaptation level produces affective arousal which motivates behavior. McClelland et. al. have not distinguished between intrinsic and extrinsic motivation. For them, all motives are learned through the pairing of cues with primary affective responses. However, the majority of the work which has derived from this theory deals with achievement motivation (Atkinson & Feather, 1966) which is generally considered intrinsic motivation (see for example, Horner, 1971). For McClelland, then, a person would be intrinsically motivated to perform an activity when some cue redintegrated an affective state initially produced by the discrepancy between an input and an adaptation level. This means, therefore, that the optimal discrepancy does not have to be present at the time that an activity is being intrinsically motivated. Rather, a cue need only redintegrate the affective state initially aroused by the discrepancy.

Dember and Earl (1957) have posited that the important incongruity or discrepancy in intrinsically motivated behaviors is between a person's expectations and the actual stimulus. A person approaches a stimulus with certain expectations about some dimension of that stimulus. This might be an expectancy about water temperature, loudness of a noise, or brightness of a light. The stimulus has some value on that dimension and the discrepancy between the expected level of the stimulus dimension and the actual level, is of central importance to the theory. Dember and

Earl hvpothesized that the maintainance of an optimal level of this incongruity between input and expectation is the psychological basis of intrinsically motivated behavior.

To the extent that expectation and adaptation level are the same concept, this theory bears some similarity to that of McClelland et. al. (1953). One might assume that the expectations one holds about a stimulus dimension are based on his adaptation level for that dimension. Dember and Earl suggested this when they said that the expectation about a stimulus property corresponds to traces left by previous exposure to that stimulus. Previous exposure, of course, determines adaptation level, so they were suggesting that expectation corresponds to adaptation level. While this may be true for rats and other animals--which were the subjects being considered by Dember and Earl, it is less likely to be so for humans. Humans have the capacity for using information in memory or obtained through communication. Lower species do not seem to have this capacity, and therefore the processes for humans would seem to be different from non-humans. For lower species, the primary determinant of expectation would be previous exposure (and therefore adaptation level), whereas for humans, previous exporsure would be only one of several determinants of expectations.

Consider the following example. A person goes for a swim in a small pool and adapts to the water temperature. When he gets out, the water temperature is changed drastically, and the person is told that the temperature has been lowered 15°F. He then goes back into the water. His adaptation level is approximately at the temerature of the water before the change (call it X°F) but his expectations are

quite different; he expects a temperature of (X-15)°F. There is a discrepancy between stimulus and adaptation level, but no discrepancy between stimulus and expectation. Clearly, however, the person will experience arousal as a result of the discrepancy between adaptation and input which will motivate him to behave in some way (e.g. get out of the water, move quickly, shiver, etc.). This suggests then, that the discrepancy between adaptation level and input is the critical discrepancy. However, returning to the example, the degree of arousal and motivation experienced by the swimmer will undoubtedly be less than it would have been had he expected X°F (his adaptation level) rather than (X-15)°F. This means that his expectations, apart from his adaptation level, are also important in determining his response. Clearly then, his arousal and motivation will be a function of the discrepancy between input on the one hand and both adaptation level and expectation on the other hand.

There is another important difference between Dember and Earl (1957) and McClelland et. al. (1953). Dember and Earl's position asserts that intrinsically motivated behavior is caused by the need for an optimal discrepancy between input and expectation at the time the behavior is motivated. As we've said, however, for McClelland et. al., the discrepancy need not exist at the time of the behavior.

Hebb (1955) postulated the need for an optimal level of arousal with which he accounts for intrinsic motivation. The basic element of his theory is arousal which he equated with a generalized drive. He stated, in essence, that functioning is most efficient when there is an optimum of arousal (or non-specific cortical bombardment). As Hebb pointed out, the notion of an optimal arousal was also suggested by Schlosberg (1954).

Since, according to Hebb's conception, organisms have a need for optimal arousal, responses which lead the organism toward that optimum will be strengthened. If his arousal is too low, a response that increases it will be strengthened; if it is too great, a response which decreases it will be strengthened (Leuba, 1955, discussed this point in more detail). When a person is confronted with an angry bear, his arousal may well be above the optimum for effective functioning. If it is not so high that he "freezes" he may be able to flee. The response of flight will lower his level of arousal and thereby be reinforced.

It is important to note again that in Hebb's theory, optimal arousal is the key concept. This is different from optimal incongruity (or discrepancy) which is central for McClelland et. al. (1953), Dember and Earl (1957), and Hunt (1965--to be discussed more fully below). Yet Hebb provided the basis for a reconciliation when he briefly addressed himself to the question of intrinsic motivation (though he did not call it that). Looking at the psychological level--rather than the physiological level (i.e. arousal), he stated, "This taste for excitement must not be forgotten when we are dealing with human motivation. It appears that, up to a certain point, threat and puzzle have positive motivating value, beyond that point negative value," (Hebb, 1955, p. 250). In otherwords, optimal arousal is the central notion, yet this may be achieved through optimal threat and puzzle, which involve an optimal incongruity between input and some standard such as adaptation level.

Fiske and Maddi (1961) took a position similar to Hebb's. They suggested that there is a characteristic (i.e. optimal) level of arousal and that organisms seek to maintain this level. That optimal level, however,

is not stationary, but rather it varies, with the stage of a person's sleep-wakefulness cycle. In otherwords, organisms do seek an optimal level of arousal, however, this optimum is a continuous variable and is a function of the organisms degree of wakefulness.

Discrepancies from the optimal level at any given time motivate the organism to engage in behavior which will restore the optimal stimulation. This stimulation can come from internal tissue needs as well as external stimuli. When a person is hungry the hunger and the process of getting and ingesting food provide stimulation. Accordingly, when primary tissue needs for food, sex, etc. are satisfied, the organism will more likely need to seek out stimuli (either external such as puzzlement or internal such as day dreaming) which increase his arousal. This suggests, then, that a person is most likely to engage in intrinsically motivated behaviors such as exploration and manipulation to increase his level of stimulation (up to the optimum for that stage of wakefulness) at times when his primary tissue needs are well satisfied.

Of course, if he is in a state of near sleep, the optimal level of arousal will be quite low, so he would not be likely to seek out much stimulation. A soft pillow would probably suffice.

Berlyne has undoubtedly written more about intrinsic motivation than any other author. In a recent paper (Berlyne, 1971), he asserted that intrinsically motivated behaviors are ones which are aimed at establishing certain internal conditions that are rewarding for the organism. These conditions are bound up with the needs of the brain,

and may be sought in order to avoid or reduce threats to the functioning of the brain. These threats to functioning, Berlyne pointed out, may be real time needs, such as a freightening stimulus (the growling bear) which could cause it to freeze. If there is no need for immediate attention to a stimulus, the brain may be involved in normal maintainance. This means that a person will behave so as to maintain an optimal level of stimulation, which is necessary for effective functioning.

Berlyne (1966) elaborated these points somewhat, by claiming that motivated behaviors can be explained physiologically by two sets of reasons. These both have to do with the needs of the brain and the fact that the brain is primarily an information processing system. The brain uses information from the environment and its memory to make choices--hopefully adaptive ones. Then, since there is always spontaneous activity in a person's central nervous system, and since this activity can underlie many different responses, it is useful for the human to secure information which will help him select adaptively from among the myriad of possible behaviors. The information which he needs to secure may be about an immediate threat or about more leisurely decisions. Second, organisms are "designed to cope with environments that produce a certain rate of influx of stimulation, information, and challenge to its capacities... [hence] we can understand why organisms may seek out stimulation that taxes the nervous system to the right extent, when naturally occuring stimuli are either too easy or too difficult to assimilate" (Berlyne, 1966, p. 26).

In the course of normal information processing the brain must compare and contrast various stimuli from the environment or memory in order to note differences and similarities. It must also categorize these elements into a meaningful system for operating and storing. Berlyne has referred to these processes as collation, and then points out that things like novelty, incongruity, etc. all involve collation of stimuli from the environment and memory. One can see then that collation is central to intrinsic motivation. "Collative stimulus properties" increase a person's stimulation and are therefore intrinsically motivating so long as they are not greater than the optimal level of arousal.

Berlyne's early work (e.g. 1950, 1955) concentrated on the rewarding properties of drive reduction. Like Hebb, he considered arousal to be a general drive state, so behaviors which reduced this would be reinforced. Exploration, for example, could serve to reduce arousal, through familiarizing the organism with the novel stimulus and thereby reduce arousal. More recently, however, (1966, 1967, 1969, 1971) he has proposed the optimal level of stimulation concept, thereby acknowledging that increases in stimulation can also be rewarding, up to the optimal level.

Collative stimulus properties hold what Berlyne (1960) has called "arousal potential." Berlyne's notion of an optimum of arousal potential (or stimulation) then suggest that a person needs an optimum of stimulation. This he can get, if he is below the optimum, by encountering stimuli with collative properties. Hence,

we find him searching out novel stimuli. If he is above the optimum, he can reduce the stimulus properties, by withdrawing or exploring the arousing stimuli. This later alternative involves a temporary increase in arousal in order to reduce it through exploration and subsequent understanding.

Hebb (1955), Leuba (1955), and Fiske and Maddi (1961) were concerned with an optimal level of arousal in the central nervous system. Berlyne, however, was concerned with an optimal level of "arousal potential," which is more akin to what Hunt (1965) and Dember and Earl (1957) have termed incongruity, and McClelland et. al. (1953) have called discrepancy from adaptation level. Here the emphasis is on the stimuli and how they differ from a standard, an expection or an adaptation level, whereas for Hebb, Leuba, and Fiske and Maddi the motivation and behavior are initiated in the physiology of the central nervous system rather than the psychological interpretation of the external stimuli.

Berlyne (1960, 1963) has discussed the relation between arousal potential and arousal in some detail. At the optimum of arousal potential, arousal is at a minimum. When arousal potential is below optimum, arousal increases because there are insufficient collative stimulus properties present and the organism experiences a boredom drive which can be reduced by encounters with more collative variables. Above the optimum arousal also increases thereby inducing generalized drive which can be reduced through escape from the over stimulation or through exploration of the stimulus. The relationship, then, between arousal potential and arousal approximates a U function with arousal

potential on the abscissa and arousal on the ordinate. This means of course that Berlyne is within a drive reduction framework. Since he equates arousal with generalized drive, he proposes that drive is reduced to a minimum by maintaining an optimal level of arousal potential. An absence of arousal potential (or collation, or novelty, etc.) is arousing, just as large amounts of arousal potential is arousing, though optimal arousal potential is minimally arousing.

On this point Berlyne's position differs markedly form that of Hebb, Leuba, and Fiske and Maddi in that they have proposed that man seeks an optimal level of arousal which is different from minimum arousal, whereas Berlyne's position suggest that man seeks optimal arousal potential and therefore minimum arousal. The issue of which position is correct is by no means settled and deserves substantial attention.

Hunt's theory of intrinsic motivation bears substantial similarity to Berlyne's. Hunt (1963) regarded the human as an information processing system and believed that intrinsic motivation is inherent in information processing and action.

In outlining a theory of intrinsic motivation, Hunt (1965) enumerated and provided his answers to several critical motivational questions. Therefore, his theory is more comprehensive than the others previously mentioned.

The first question was the instigation question; what initiates and terminates behavior? Hunt answered the question within the framework of the feedback loop as conceptualized by Miller, Galanter, and Pribram (1960). Their model is called the TOTE unit, which stands for Test, Operate, Test, Exit. Within the TOTE unit, there is a mechanism which

compares the input to some standard such as an adaptation level, an expectation, etc. When there is a incongruity between the input stimulus and the standard of comparison, the organism will be motivated to behave, that is, he will in some way Operate to reduce the incongruity. As he Operates, there will be continual Testing of the stimulus and standard. The Operating will continue so long as the incongruity exists; however when there is finally a congruity, between the stimulus and standard, the Operation will terminate (i.e. Exit) and the organism will be freed of this process.

This operation of the TOTE unit may be processed either in the conscious or the non-conscious. For example, when someone practices the violin, he listens to himself. The auditory input is compared with some standard in his memory and if there is incongruity he goes back over the incongruous part (i.e. he Operates) until he has matched the standard. At that point, he probably will go on to something else. This processing of information is done consciously--the person is quite aware of what he is doing.

However, at other times the processing is not conscious. Consider the case of "hunger" and eating. We know that there are many cues both internal and external which control a person's experience of hunger (e.g. Schacter, 1971). Although it is not clear to what extent a person's blood sugar level controls his hunger and eating, it is clear that blood sugar level plays some part (see for example, Grossman, 1967, ch. 6). We also know that the neural circuits which control hunger and satiation are centered in the ventral-medial and lateral hypothalamus. The processing then would proceed as follows. The blood sugar level

would be compared to a standard, namely, the optimal level of sugar concentration in the blood. If the present level is incongruous with the standard, the person experiences hunger and initiates behavior to reduce the incongruity. The person is not aware of the TOTE processing which he is doing in this case; however, it seems to work in the same way it does when the violinist perfects his music.

One can also see from these two examples that the standards can be either innate as in the case of the optimal blood sugar level, or acquired (at least in part) through informational interaction with one's environment as in the case of the violinist.

The next question which Hunt dealt with was the energization question. What is it that provides the energy for an organism to engage in an intrinsically motivated activity?

The answer to this question also centered around the notion of incongruity. Hunt used this notion to answer the question in two general ways. The first was within the realm of drive theory, and the second, information processing theory.

First, the drive reduction approach. Hunt pointed out that an incongruity between the situation and a person's expectations or plans involves either unfinished business or frustration, either of which is energy producing. The well-known Zeigarnik effect is an example of how this would work. An abundance of evidence indicates that people are motivated to finish uncompleted tasks (Zeigarnik, 1927) and to remember uncompleted tasks more often than completed ones (Rickers-

Ovsiankina, 1928). It seems reasonable then, that incongruities which take the form of uncompleted tasks or plans would motivate the organism toward completion of these activities.

Hunt also suggested that incongruity causes frustration and that frustration can be motivating. When there is an incongruity between actions and plans, there is frustration because the plans are being interferred with. Since these plans are presumably intended to reduce some drive, the incongruity interfers with the drive reduction, thereby establishing the drive. Furthermore, frustration seems to energize some behaviors directly. Dollard, Doob, Miller, Mowrer and Sears (1939) for example, have hypothesized that frustration energizes aggressive behavior.

By using a drive theory approach to answer the energization question, Hunt was restricting the explanatory power of incongruity as a source of energy. Incongruity seems to energize only when it involves unfinished tasks or frustration. Surely, however, there are other forms of incongruity. The orienting reflex is one example of a response to an incongruity between a stimulus input and an adaptation level (Helson, 1964) which does not necessarily involve an incomplete task or frustration.

When Hunt uses an information processing approach to answer the question, the answer has the advantage of being able to include all forms of incongruity, however, it has the disadvantage of being less precise in its formulation. In essence, Hunt postulated that incongruity between a stimulus and standard is by itself motivating. He cited the William James (1890) example of orienting to a clock only when its

ticking ceases, and he pointed out that this incongruity produces energy which cannot easily be accounted for by drive theory.

Numerous other examples exist which indicate that any incongruity from an adaptation level can motivate a response. This supports the information processing interpretation that when a stimulus is compared to a standard such as adaptation level and there is a discrepancy, the organism will be aroused. Repeated encounters with this discrepancy will of course lead to a change in adaptation such that there will no longer be incongruity and therefore no arousal.

Another motivational question which Hunt considered was the direction-hedonic question. Toward what and away from what will an organism move?

In answering this question, Hunt proposed the central hypothesis in this theoretical position, namely, that organisms need an optimal amount of incongruity and will seek out those situations which provide them with that optimal. When there is insufficient incongruity, they will approach situations which provides more (up to the optimal) and avoid situations which provide less. So also, if one is over stimulated by incongruity, he will approach situations with less, and avoid situaitons with more.

Hunt's position holds that it is optimal incongruity as opposed to optimal arousal which is the critical element in intrinsic motivation. His focus, then, is primarily at the psychological level rather than the physiological level, so his position on this dimension is nearest to McClelland et. al. (1953) Berlyne (1966), and Dember and Earl (1957) and furthest from Hebb (1955), Leuba (1955), and Fiske and Maddi (1961). Hunt reviewed some data which attempted to distinguish these two positions and concluded that the data is quite inconclusive.

The next motivational question which Hunt considered was the termination question. What causes an organism to terminate an intrinsically motivated behavior such as manipulation or exploration? The answer was based in the work on the orienting reflex (cf. Sokolov, 1960) and fitted neatly into Hunts information processing approach to motivation. The essence of the answer is that organisms habituate to novel stimuli upon repeated presentation, so that the stimuli lose their incongruity. This notion is also central to Helson's adaptation level theory (1964). An organism's adaptation level changes in the direction of the stimulus which it encounters. Soon, the stimulus and adaptation level are the same and there is no discrepancy.

When an organism explores, manipulates or tries some new activity, he will work at it avidly for awhile and gradually become bored. Leavitt (1962) has pointed out that people, when they encounter novel or puzzling situation, program the novelty in such a way that they understand it and become bored with it. For example, when someone knows the algorithm to a puzzle, the puzzle will no longer be intrinsically motivating. It provides no novelty or incongruity. Kagan (1972) made a similar point. Repeated exposure to a novel stimulus will eventually mean that the stimulus loses its intrinsically motivating properties, or its collative properties (Berlyne, 1971). The incongruity is lost when the adaptation level becomes the same as the stimulus, or when the organism "understands" the stimulus.

The Reduction of Uncertainty

Another approach to explaining intrinsically motivated behavior involves uncertainty reduction. Kagan (1972) has asserted that this is the goal of one class of human motives. For him, a goal is a cognitive representation of future events which will make one feel better, and a motive is the cognitive representation of the desired end state. Kagan believes that the motive to resolve uncertainty is one of the important classes of motives, and that it can explain a considerable amount of behavior.

Uncertainty "is characterized, in part, by imcompatibility between [two or more] cognitive structures, between cognitive structures and experience, or between cognitive structures and behavior," [Kagan, 1972, p. 54]. This notion is similar to Festinger's theory of cognitive dissonance (1957), which asserted that organisms are motivated to reduce dissonance, since dissonance is experienced as a disphoric state. Incompatibility between two cognitions is precisely what Festinger meant by cognitive dissonance. Further, incompatibility between a cognition and behavior is also frequently considered within the realm of cognitive dissonance. For example, a person may believe in one thing and behave in a way that is discordant with the belief. He then holds two dissonant cognitions; the first is the knowledge of his belief and the second is the knowledge of his discordant behavior. This form of incompatibility has been the basis of many studies on attitude change. If a person has an attitude which is dissonant with his behavior, he can reduce that dissonance in several ways, most likely by changing the attitude or changing the behavior. The area of counterattitudinal advocacy is precisely this idea. If a person is asked to argue a position other than what he

believes, he will experience dissonance and will reduce this by changing his attitude in the direction of the position which he advocated. Zimbardo (1969) provided substantial support for this notion.

A third source of uncertainty which Kagan considered was incompatibility between a cognition and an experience. This is quite clearly related to the incongruity or discrepancy which we have considered already. McClelland et. al. (1953) asserted that a motive is the redintegration of an affectively toned association which generally arises out of a discrepancy between an experience and a cognition, in particular, the awareness of an adaptation level. Dember and Earl (1957) also accounted for intrinsically motivated behaivor in terms of incompatibility between an expectation and an input and Hunt (1965) considered the incompatibility between a cognition (or standard) and an experience. Kagan points out that Hunt considered only this incompatibility and ignored the other sources of uncertainty. While this may be so, Hunt's information processing theory could easily incorporate the other two sources of uncertainty previously mentioned. Indeed, a behavior provides an input into the information processing system (i.e. the central nervous system) which is compared to a cognition (i.e. a standard). So also, a cognition can be compared to another cognition within Hunt's basic framework.

We have seen therefore that the reduction of uncertainty as considered thus far bears considerable similarity to the notion of incongruity. The

important difference, however, is that Kagan and Festinger proposed that organisms are motivated to reduce all uncertainty or dissonance whereas others such as Hunt proposed that organisms need some optimal amount of incompatibility (i.e. uncertainty) which is greater than zero. The evidence previously reviewed seems to support this latter position quite clearly. While organisms often behave to reduce uncertainty, dissonance, or incongruity, they also behave so as to induce uncertainty, dissonance or incongruity.

A final source of uncertainty which Kagan considered was one's ability to predict future events. This goal is particularly salient when there is a possibility that the event may be unpleasant or painful, because this type of uncertaintly is likely to be anxiety provoking and distressful.

When a person experiences uncertainty as a child, Kagan said, he may develop one of many different strategies for dealing with it. He can, for example, use the strategy of sticking close to his parents, in which case he'll develop a dependency motive, or he could seek praise and reassurance in which case he'd develop a motive for recognition or approval. He could also choose to bully a weaker child and develop a motive for dominance, or he could learn to withdraw because the people whom he has approached for help in dealing with his uncertainty have somehow failed him. Any of the strategies which he employs leads to the development of specific motives; all however are fundamentally motivated by the intrinsic need to reduce uncertainty.

The first three sources of uncertainty all involve aleviating an incongruity. The final source, however, is more general. There need be no specific stimulus (i.e. no incongruity) to motivate behavior. People want to be able to predict the future so they do many things to enhance their ability to predict. One of the most common behaviors motivated by this need is gathering information. In this sense, one can think of curiosity as the same thing as the need to predict the future.

Berlyne (1971) has considered curiosity to be synonomous with the need to reduce uncertainty. He speaks of specific exploration which is exploratory behavior that results from a motivational condition called uncertainty. In otherwords, specific exploration is any kind of behavior which is intended to reduce some uncertainty, i.e. to satisfy curiosity. In this sense, curiosity has a restricted definition. Curiosity as Berlyne (1971) defined it is not related to the class of behaviors which are not aimed at reducing uncertainty or eliminating an incongruity. Much exploration, learning, etc. seems to be motivated by a need to know. Koch's (1956) conception of intrinsic motivation would allow for people to learn or explore simply because those behaviors are rewarding in and of themselves. People like learning or understanding and that becomes the important thing to them. The exploring and learning is an end in itself, not a means to reduce uncertainty. Kagan's (1972) theory could account for this by considering the need to know as a secondary motive deriving out of a strategy which the person choses to reduce uncertainty..

The "need to know" phenomena could also be accounted for by the optimal stimulation notion. When a person experiences too little stimulation he seeks out novelty, that is, he explores, manipulates etc. So behavior which appears to be for its own sake, could be motivated by the need for optimal stimulation. Berlyne (1971) referred to this as diversive exploration and did not consider it to be within his definition of curiosity, though he acknowledged that other people define it differently. Putting both specific and diversive exploration into an optimal incongruity framework, we see that if a person experiences too much uncertainty (i.e. incongruity) he engages in specific exploration to reduce this uncertainty. When, however, he experiences too little incongruity, he engages in diversive exploration so as to achieve the needed stimulation.

Lanzetta and his associates (e.g. Lanzetta, 1963, 1971) have done a considerable amount of research on the motivating properties of uncertainty. Their investigations were concerned primarily with response uncertainty and choice behaviors. Their research has shown that search behavior is motivated by response uncertainty and that this search behavior will be a monotonically increasing function of the amount of uncertainty. Further, people will choose alternatives which they believe will be most instrumental in reducing uncertainty.

Their research (Driscoll and Lanzetta, 1964 and Hawkins and Lanzetta, 1965) also supports Kagan's (1972) notion that the need to reduce uncertainty is not a tension or deprivation need by showing no relation between uncertainty (induced experimentally) and arousal.

Competence and Self-determination

The focus of this approach to understanding intrinsic motivation is on the need and capacity of organisms to deal effectively with their environment. Woodworth's behavior primary theory (1918, 1958), for example, holds that one's behavior is generally aimed at producing an affect on his environment. This behavior is on-going and basic, so that behavior directed at satisfying deprivation needs like hunger has to break into this flow of activity. Woodworth, then, viewed man as a more complete organism which is continually in tune with it's surroundings and itself. It acts on its environment, and attends to its own internal biological needs.

White's (1959) well known concept of competence is within the same general camp. It rejects drive reduction theory as an adequate explanation of human motivation, and places considerable importance on a person's interaction with his environment. Competence refers to one's ability or capacity to deal effectively with his surroundings. This concept encompasses such things as exploration, manipulation, attention, perception, thought, and communication since all these activities are necessary for acting on one's environment effectively. However, the concept is a motivational one; that is, White posited a "competence motivation" or "effectance motivation" which is what directs exploration, manipulation, attention, etc. The behaviors that lead to effective manipulating, for example, are selective, persistent, and directed.

They are not random, they are motivated by the intrinsic need to deal effectively with the environment.

White like Berlyne asserted that the energy for intrinsically motivated behavior comes from the central nervous system rather than tissue needs. External stimuli influence the direction of intrinsically motivated behavior, yet they play very little part in energizing it.

Effectance motivation is persistent in that it is always available to occupy "the spare waking time between episodes of homeostatic crisis." (White, 1959, p. 321). That is, effectance motivation is not intense and immediate in the sense that thirst, fear, etc. are, but rather it is an on going process which is periodically interupted by tissue needs. Though, of course, there are also times when a hungry, cold, or pained person will stick to an intrinsically motivated activity in spite of his tissue needs.

Effectance motivation motivates behaviors which allow a person to have feelings of efficacy. Therefore, he is intrinsically motivated by effectance motivation to engage in behaviors which allow him to feel competence or efficacy.

White pointed out that in young children, effectance motivation may be quite undifferentiated, whereas with additional experience they become differentiated into more specific motives for mastery, cognizance or achievement. These specific motives would be learned through experiences which emphasize different aspects of effective functioning vis-a-vis the environment, yet effectance motivation is the source of these later differentated motives.

This concept of differentiation of motives through experience parallels Kagan's (1972) formulation, though Kagan talks of more widespread motives such as dependence and approval developing out of the central need, viz. the reduction of uncertainty.

Angyal (1941) like White placed considerable importance on the notion of competence in dealing with one's environment. An organism increases autonomy through asquisition of competency in dealing with it's environment. Angyal suggest that humans have a tendency toward self-determination, which is a notion very similar to that of effectance motivation, for someone who is self-determining will feel efficacy. In otherwords, for Angyal the tendency toward self-determination would seem to be the essence of intrinsic motivation.

The notions of competence and self-determination also appear in the work of de Charms (1968). He stated that, "Man's primary motivational propensity is to be effective in producing changes in his environment. Man strives to be a causal agent, to be the primary locus of causation for, or the origin of, his behavior; he strives for personal causation." (de Charms, 1968, p. 269). For de Charms, then, intrinsically motivated behaviors are those which a person does in order to feel personal causation. He pointed out that personal causation is not the motive of all behavior. Rather, proposing a notion similar to that of Kagan and White, he asserted that this general motive differentiates into specific motives as a result of experiences with one'e environment. Indeed, according to de Charms, the desire to be in control of one's fate is a contributing factor to all motives.

In further discussing the notion of intrinsic motivation, de Charms used Heider's (1958) concept of perceived locus of causality. De Charms (1968) stated, "... whenever a person experiences himself to be the locus of causality for his own behavior..., he will consider himself to be intrinsically motivated. Conversely, when a person perceives the locus of causality for his behavior to be external to himself..., he will consider himslef to be extrinsically motivated."

Deci (1972a) and Deci, Cascio, and Krusell (1973) have also asserted that a person engages in many behaviors because they allow him to feel a sense of competence and self-determination. Using this definition of intrinsic motivation and the results of several recent investigations which have demonstrated that extrinsic rewards affect intrinsic motivation, Deci has developed a cognitive evaluation theory to account for the results.

Experiments have shown that: money (Deci, 1971, 1972a) and the avoidance of punishment (Deci, and Cascio, 1972) decreased college students' intrinsic motivation for solving puzzles; good player awards decreased preschool children's intrinsic motivation for playing with drawing materials (Lepper, Greene, and Nisbett, in press), and prizes decreased elementary school children's enjoyment of competitive games (Kruglanski, Alon, and Lewis, 1972).

On the other hand, Deci (1971, 1972a) has demonstrated that male subjects displayed an increased amount of intrinsic motivation when they were rewarded with positive verbal feedback from the experimenter, though the opposite was so for females (Cascio, Deci, and Krusell, 1974).

Finally, negative feedback about a person's performance on an intrinsically motivated activity also decreased intrinsic motivation (Cascio, Deci, and Krusell, 1974).

To account for these findings cognitive evaluation theory (Deci, 1972b) asserts that there are two processes by which intrinsic motivation can be affected: (1) a change in perceived locus of causality and (2) a change in one's feelings of competence and self-determination.

When a person is intrinsically motivated the locus of causality (Heider, 1958; de Charms, 1968) is within himself. However, when he receives external rewards he begins to perceive that he is doing the activity for the external reward, so the perceived locus of causality changes from within himself to the external reward leaving him with less intrinsic motivation.

People are intrinsically motivated to perform activities which make them feel competent and self-determining. Therefore, rewards or feedback can affect their intrinsic motivation by affecting their feelings of competence and self-determination. Rewards or feedback that strengthen these feelings enhances intrinsic motivation and feedback (or punishment) that weakens these feelings decreases intrinsic motivation.

The fact that some rewards increase intrinsic motivation and others decrease it, is caused by the fact that every reward has two aspects. The first is a controlling aspect which initiates the change in perceived locus of causality process. The other aspect to every reward is the information

it gives a person about his competence and self-determination. Therefore, whether the "change in perceived locus of causality" process or the "change in feelings of competence and self-determination" process will be evoked depends on which aspect of the reward is more salient. With money and avoidance of punishment, for example, the controlling aspect is very apparent, and indeed they lead to a decrease in intrinsic motivation by changing the perceived locus of causality. On the other hand, the controlling aspect of positive feedback is much less salient, so the informational aspect would be more operative. This would lead to an increase in intrinsic motivation by strengthening the person's sense of competence and self-determination.

With females, however, the story was different. Apparently, socialization processes lead females to be more sensitive to praise and approval and more dependent on such rewards, so praise (or positive feedback) initiated the change in perceived locus of causality process thereby decreasing their intrinsic motivation.

With negative feedback, a person's sense of competence and self-determination is weakened and consequently his intrinsic motivation decreases. This happened with both verbal negative feedback and failure.

The work of humanistic psychologists, most notably Goldstein (1939) and Maslow (1943, 1954) have developed and emphasized the concept of self-actualization. This is a motivational concept, in that Maslow asserts that man is motivated to actualize his unique potential, that is, to become all that he is capable of. This bears some similarity to the notion of effectance motivation, yet there are differences. Maslow has posited

a hierarchical nature to needs, such that self actualization is the salient need only after all other needs have been satisfied. This presumably would happen primarily late in life, if at all. Effectance motivation, however, is always present and motivates behavior from the time of birth. The positions seem most easily reconciled by assuming that self-actualization is a specific motive, like achievement, cognizance, etc. which develops from the basic undifferentiated effectance motivation.

Concluding Comments

The evidence is quite clear, people as well as lower animals engage in a substantial amount of intrinsically motivated behavior and theories of motivation need to be modified to account for "rewards that do not reduce tissue needs" (Eisenberger, 1972).

Theories will have to account for the fact that behavior is motivated both by the need to reduce stimulation and the need to induce stimulation. This fact seems to be quite easily handled by three approaches to understanding intrinsic motivation: optimal arousal theories (e.g. Hebb, 1955; Leuba, 1955), optimal incongruity theories (e.g. Hunt, 1965; Dember and Earl, 1957; and McClelland et. al., 1953), and competence and self-determination theories (e.g. White, 1959; de Charms, 1968; and Deci, 1972a).

These three sets of theories focus on different things, yet they may be reconcilable. We previously suggested that optimal arousal may be the physiological process which underlies optimal incongruity, the later being the psychological experience of the physiological process. There is little evidence bearing on the relationship ot the two proceesses, yet there is substantial evidence supporting each position, and the notion that the two processes may be linked is intuitively appealing. It may be that

one process is the causal factor and the other epiphenomenal, though this is unclear.

It also seems possible to incorporate the need for optimal incongruity into competence and self-determination theories. To do this, it would be necessary to detail more precisely what makes an organism feel competent and self-determining. The advantage to this approach would be that it is more inclusive at the same time that it would have the precision of the optimal incongruity approach. We are suggesting that people, motivated detail more precisely what makes an organism feel competent and self-determining. The advantage to this approach would be that it is more inclusive at the same time that it would have the precision of the optimal incongruity approach. We are suggesting that people, motivated by a need to feel competent and self-determining, will engage in behaviors which result in a moderate amount of psychological stimulation. People seem to be engaged in the process of "seek and conquer." That is, a person who gets no stimulation will not feel competent in dealing with his environment. He will probably feel "blah." He seeks out stimulation; he seeks out the opportunity to behave in ways which allow him to feel competent and self-determining. However, he will also need to "conquer" situations with over stimulation. Too much stimulation leaves him frustrated and anxious. Only when he has dealt with this over stimulation (a frightening bear, too much work, etc.) will he feel competent and self-determining. He will feel in charge of his universe when he is able to seek out pleasurable stimulation and deal effectively with over stimulation.

The need to reduce uncertainty and cognitive dissonance may simply be specific cases of the need to feel competent and self-determining. However, we've also seen that organisms behave so as to induce uncertainty and dissonance. Some kinds of uncertainty and dissonance or certain

amounts of it constitute pleasureable stimulation.

If the need for competence and self-determination is the psychological basis of intrinsically motivated behavior, we will need to determine the physiological correlates of this psychological motivation. White (1959) has stated that, "In our present state of relative ignorance about the workings of the nervous system it is impossible to form a satisfactory idea of the neural basis of effectance [i.e. competence] motivation," (p.322). He adds that it does not include all neural action; it does not include reflexes, automatized patterns, behavior motivated by tissue needs, or random behavior, but rather it refers to, "behavior that shows a lasting focalization and that has the characteristics of exploration and experimentation .... When this particular sort of activity is aroused in the nervous system, effectance motivation is being aroused,..." (White, 1959, p. 323).

Although White does not postulate a physiological basis for competence motivation, it seems clear from the work of Hebb and others that the physiological basis is probably at least partly in the reticular activating system. As Berlyne (1966) points out, the central nervous system needs a certain amount of stimulation and also a certain amount of information to make adaptive choices. So they engage in behavior which provide the optimal stimulation and which provide information for the central processing system to make adaptive responses and the result of this is the knowledge and feeling of competence and self-determination.

REFERENCES

Allport, G.W. Personality: A psychological interpretation. New York: Holt, 1937.

Angyal, A. Foundations for a science of personality. New York: Commonwealth Fund, 1941.

Aristotle. Metaphysico, 980. Translated by W.D. Ross as The works of Aristotle. Oxford: Clarendon Press, 1924, Vol. 8.

Aronson, E. The psychology of insufficient justification. In S. Feldman (Ed.), Cognitive Consistency. New York: Academic Press, 1965, Pp. 109-133.

Atkinson, J.W., & Feather, N.T. (Eds.), A theory of achievement motivation. New York: Wiley, 1966.

Berlyne, D.E. Novelty and curiosity as determinants of exploratory behavior. British Journal of Psychology, 1950, 41, 68-80.

Berlyne, D.E. The arousal and satiation of perceptual curiosity in the rat. Journal of Comparative and Physiological Psychology, 1955, 48, 238-246.

Berlyne, D.E. Conflict arousal and curiosity. New York: McGraw-Hill, 1960.

Berlyne, D.E. Motivational problems raised by exploratory and epistemic behavior. In S. Koch (Ed.), Psychology: A study of a science. Vol. 5. New York: McGraw-Hill, 1963.

Berlyne, D.E. Exploration and curiosity. Science, 1966, 153, 25-33.

Berlyne, D.E. Arousal and reinforcement. Nebraska Symposium on Motivation, 1967, 15, 1-110.

Berlyne, D.E. The reward-value of different stimulation. In J.T. Trapp (Ed.), Reinforcement and behavior. New York: Academic Press, 1969.

Berlyne, D.E. What next? Concluding summary. In H.I. Day, D.E. Berlyne, and D.E. Hunt (Eds.), Intrinsic motivation: A new direction in education. Toronto: Holt, Rinehart, and Winston of Canada, 1971, Pp, 186-196.

Bexton, W.H., Heron, W., & Scott, T.H. Effects of decreased variation in the sensory environment. Canadian Journal of Psychology, 1954, 8, 70-76.

Butler, R.A. Discrimination learning by rhesus monkeys to visual exploration motivation. Journal of Comparative and Physiological Psychology, 1953, 46, 95-98.

Butler, R.A. Incentive conditions which influence visual exploration. Journal of Experimental Psychology, 1954, 48, 19-23.

Butler, R.A. The effect of deprivation of visual incentives on visual exploration motivation in monkeys. Journal of Comparative and Physiological Psychology, 1957, 50, 177-179.

Butler, R.A. The differential effect of visual and auditory incentives on the performance of monkeys. American Journal of Psychology, 1958, 71, 591-593.

Butler, R.A., & Harlow, H.F. Discrimination learning and learning sets to visual exploration incentives. Journal of Genetic Psychology, 1957, 57, 257-264.

Cascio, W.F., Deci, E.L., & Krusell, J. The cognitive evaluation of feedback. Unpublished manuscript, University of Rochester, 1974.

Dashiell, J.F. A quantitative demonstration of animal drive. Journal of Comparative Psychology, 1925, 5, 205-208.

Davis, R.T., Settlage, P.H., & Harlow, H.F. Performance of normal and brain-operated monkeys on mehcanical puzzles with and without food incentive. Journal of Genetic Psychology, 1950, 77, 305-311.

de Charms, R. Personal causation: The internal affective determinants of behavior. New York: Academic Press, 1968.

Deci, E.L. Effects of externally mediated rewards on intrinsic motivation. Journal of Personality and Social Psychology, 1971, 18, 105-115.

Deci, E.L. Intrinsic motivation, extrinsic reinforcement and inequity. Journal of Personality and Social Psychology, 1972, 22, 113-120 (a).

Deci, E.L. Effects of contingent and non-contingent rewards and controls on intrinsic motivation. Organizational Behavior and Human Performance, 1972, 8, 217-229 (b).

Deci, E.L., & Cascio, W.F. Changes in intrinsic motivation as a function of negative feedbac'. and threats. Eastern Psychological Association Convention, Boston, Mass., April, 1972.

Deci, E.L., Cascio, W.F., & Krusell, J. Sex differences, verbal reinforcement, and intrinsic motivation. Eastern Psychological Association Convention, Washington, D.C., May, 1973.

Dember, W.N., & Earl, R.W. Analysis of exploratory, manipulatory, and curiousity behaviors. Psychological Review, 1957, 64, 91-96.

Dollard, J., Doob, L.W., Miller, N.E., Mowrer, O.H., & Sears, R.R. Frustration and aggression. New Haven: Yale University Press, 1939.

Driscoll, J.M., & Lanzetta, J.T. Effects of problem uncertainty and prior arousal on predecisional information search. Psychological Reports, 1964, 14, 975-988.

Eisenberger, R. Explanation of rewards that do not reduce tissue needs. Psychological Bulletin, 1972, 77, 319-339.

Festinger, L. A theory of cognitive dissonance. Evanston, Ill.: Row, Peterson, 1957.

Fiske, D.W., & Maddi, S.R. Functions of varied experience. Homewood, Ill.: Dorsey, 1961.

Fowler, H. Curiosity and exploratory behavior. New York: Macmillan, 1965.

Fowler, H. Satiation and curiosity. In K.W. Spence and J.T. Spence (Eds.), Psychology of learning and motivation, Vol. 1. New York: Academic Press, 1967, Pp. 157-227.

Gately, M.J. Manipulation drive in experimental naive rhesus monkeys. Unpublished master's thesis, University of Wisconsin, 1950.

Glanzer, M. Stimulus satiation: An explanation of spontaneous alternation and related phenomena. Psychological Review, 1953, 60, 257-268.

Glanzer, M. Curiosity, exploratory drive, and stimulus satiation. Psychological Bulletin, 1958, 55, 302-315.

Goldstein, K. The organism. New York: American Books, 1939.

Grossman, S.P. A textbook of physiological psychology. New York: Wiley, 1967.

Haber, R.N. Discrepancy from adaptation level as a source of affect. Journal of Experimental Psychology, 1958, 56, 370-375.

Harlow, H.F. Learning and satiation of response in intrinsically motivated complex puzzle performance by monkeys. Journal of Comparative and Physiological Psychology, 1950, 43, 289-294.

Harlow, H.F. Motivation as a factor in the acquisition of new responses. Nebraska symposium on motivation, 1953, 1, 24-49.(a).

Harlow, H.F. Mice, monkeys, men and motives. Psychological Review, 1953, 60, 23-32 (b).

Harlow, H.F., Harlow, M.K., & Meyer, D.R. Learning motivated by a manipulation drive. Journal of Experimental Psychology, 1950, 40, 228-234.

Hawkins, C.K., & Lanzetta, J.T. Uncertainty, importance, and arousal as determinants of predecisional information search. Psychological Reports, 1965, 17, 791-800.

Hebb, D.O. The forms and conditions of chimpanzee anger. Bulletin of the Canadian Psychological Association, 1945, 5, 32-35.

Hebb, D.O. Emotion in man and animal: An analysis of the intuitive processes of recognition. Psychological Review, 1946, 53, 88-106 (a).

Hebb, D.O. On the nature of fear. Psychological Review, 1946, 53, 259-276 (b).

Hebb, D.O. The organization of behavior. New York: Wiley, 1949.

Hebb, D.O. Drives and the c.n.s. (conceptual nervous system). Psychological Review, 1955, 62, 243-254.

Hebb, D.O., & Riesen, A.H. The genesis of irrational fears. Bulletin of the Canadian Psychological Association, 1943, 3, 49-50.

Hebb, D.O., & Thompson, W.R. The social significance of animal studies. In G. Lindzey (Ed.), Handbook of Social Psychology, Vol. 1. Reading, Mass.: Addison-Wesley, 1954. Pp. 532-561.

Heider, F. The psychology of interpersonal relations. New York: Wiley, 1958.

Helson, H. Adaptation-level theory. New York: Harper and Row, 1964.

Hendrick, I. Instinct and the ego during infancy. Psychoanalytic Quarterly, 1942, 11, 33-58.

Hendrick, I. The discussion of the "instrinct to master." Psychoanalytic Quarterly, 1943, 12, 561-566.

Heron, W., Doane, B.K., & Scott, T.H. Visual disturbances after prolonged perceptual isolation. Canadian Journal of Psychology, 1956, 10, 13-18.

Horner, M.S. The psychological significane of success in competitive achievement situations: A threat as well as a promise. In H.I. Day, D.E. Berlyne, & D.E. Hunt (Eds.), Intrinsic motivation: A new direction in education. Toronto: Holt, Rinehart, and Winston of Canada, 1971. Pp. 46-60.

Hull, C.L. Principles of behavior. New York: Appleton-Century, 1943.

Hunt, J. McV. Motivation inherent in information processing and action. In O.J. Harvey (Ed.), Motivation and social interaction. New York: Ronald, 1963. Pp. 35-94.

Hunt, J. McV. Intrinsic motivation and its role in psychological development. Nebraska symposuim on motivation, 1965, 13, 189-282.

Hunt, J. McV. Toward a history of intrinsic motivation. In H.I. DAy, D.E. Berlyne, and D.E. Hunt (Eds.), Intrinsic motivation: A new direction in education. Toronto: Holt, Rinehart, and Winston of Canada, 1971. Pp. 1-32 (a).

Hunt, J. McV. Intrinsic motivation: Information and circumstances. Also Intrinsic motivation and psychological development. In H.M. Schroder & P. Suedfeld (Eds.), Personality theory and information processing. New York: Ronald, 1971. Pp. 85-177 (b).

Isaac, W. Evidence for a sensory drive in monkeys. Psychological Reports, 1962, 11, 175-181.

James, W. The principles of psychology, Vol. I and II. New York: Holt, 1890.

Jones, A. Supplementary report: Information deprivation and irrelevant drive as determiners of an instrumental response. Journal of Experimental Psychology, 1961, 62, 310-311.

Jones, A., Wilkinson, H.J., & Braden, I. Information deprivation as a motivational variable. Journal of Experimental Psychology, 1961, 62, 126-137.

Kagan, J. Motives and development. Journal of Personality and Social Psychology, 1972, 22, 51-66.

Keller, F.S. Learning: Reinforcement theory. 2nd edition. New York: Random House, 1971.

Koch, S. Behavior as "intrinsically" regulated: Work notes toward a pre-theory of phenomena called "motivational." In M.R. Jones (Ed.), Nebraska symposium on motivation, 1956.

Koch, S. Psychological science versus the science-humanism antinomy: Intimations of a significant science of man. American Psychologist, 1961, 16, 629-639.

Kruglanski, A.N., Alon, S., & Lewis, T. Retrospective misattribution and task enjoyment. Journal of Experimental Social Psychology, 1972, 8, 493-501.

Lanzetta, J.T. Information acquisition in decision making. In D.J. Harvey (Ed.), Motivation and social interaction. New York: Ronald Press, 1963. Pp. 239-265.

Lanzetta, J.T. The motivational properties of uncertainty. In H.I Day, D.E. Berlyne, & D.E. Hunt (Eds.), Intrinsic motivation: A new direction in education. Tronoto: Holt, Rinehart. & Winston, 1971. Pp. 134-147.

Leavitt, H.J. Unhuman organizations. Harvard Business Review, 1962, 40, 90-98.

Lepper, M.R., Greene, D., & Nisbett, R.E. Undermining children's intrinsic interest with extrinsic rewards: A test of the "overjestification" hypothesis. Journal of Personality and Social Psychology, in press.

Leuba, C. Toward some integration of learning theories: The concept of optimal stimulation. Psychological Reports, 1955, 1, 27-33.

Maslow, A.H. A theory of human motivation. Psychological Review, 1943, 50, 370-396.

Maslow, A.H. Motivation and personality. New York: Harper, 1954.

McClelland, D.C., Atkinson, J.W., Clark, R.W., & Lowell, E.L. The achievement motive. New York: Appleton-Century-Crofts, 1953.

McDougall, W. Social psychology. New York: Luce & Co., 1908.

Miller, G.A., Galanter, E., & Pribram, K.H. Plans and the structure of behavior. New York: Holt, 1960.

Montgomery, K.C. A test of two explanations of spontaneous alternation. Journal of Comparative and Physiological Psychology, 1952, 45, 287-293.

Montgomery, K.C. Exploratory behavior as a function of "similarity" of stimulus situations. Journal of Comparative and Physiological Psychology, 1953, 46, 129-133.

Montogmery, K.C. The role of exploratory drive in learning. Journal of Comparative and Physiological Psychology, 1954, 47, 60-64.

Montgomery, K.C. The relation between fear induced by novel stimulation and exploratory behavior. Journal of Comparative and Physiological Psychology, 1955, 48, 254-260.

Montgomery, K.C., & Segall, M. Discrimination learning based upon the exploratory drive. Journal of Comparative and Physiological Psychology, 1955, 48, 225-228.

Myers, A.K., & Miller, N.E. Failure to find a learned drive based on hunger: Evidence for learning motivated by "exploration." Journal of Comparative and Physiological Psychology, 1954, 47, 428-436.

Nissen, H.W. A study of exploratory behavior in the white rat by means of the obstruction method. Journal of Genetic Psychology, 1930, 37, 361-376.

Premack, D. Toward empirical behavior laws: I. Positive reinforcement. Psychological Review, 1959, 66, 219-233.

Premack, D. Reversibility of the reinforcement relation. Science, 1962, 136, 255-257.

Premack, D. Rate differential reinforcement in monkey manipulation. Journal of the Experimental Analysis of Behavior, 1963, 6, 81-89.

Rickers-Ovsiankina, M. Die Wiederaufnahme unterbrochenes Handlunger. Psychologische Forschung, 1928, 11, 302-375.

Schacter, S. Some extraordinary facts about obese humans and rats. American Psychologist, 1971, 26, 129-144

Schlosberg, H. Three dimensions of emotion. Psychological Review, 1954, 61, 81-88.

Sokolov, E.N. Neural models and the orienting reflex. In M.A.B. Brazier (Ed.), The central nervous system and behavior. New York: Josiah Macy, Jr. Foundation, 1960.

Welker, W.L. Some determinants of play and exploration in chimpanzees. Journal of Comparative and Physiological Psychology, 1956, 49, 84-89 (a).

Welker, W.L. Effects of age and experience on play and exploration of young chimpanzees. Journal of Comparative and Physiological Psychology, 1956, 49, 223-226 (b).

White, R.W. Motivation reconsidered: The concept of competence. Psychological Review, 1959, 66, 297-333.

Woodworth, R.S. Dynamic psychology. New York: Columbia University Press, 1918.

Woodworth, R.S. Dynamics of behavior. New York: Holt, 1958.

Zeigarnik, B. Das behalten erledigter und unerledigter handlungen. Psychologische Forschung, 1927, 9, 1-85.

Zimbardo, P.G. The cognitive control of motivation. Glenview, Ill.: Scott, Foresman, 1969.

Zimbardo, P.G., & Miller, N.E. Facilitation of exploration by hunger in rats. Journal of Comparative and Physiological Psychology, 1958, 51, 43-46.

Distribution List

NAVY

4 Dr. Marshall J. Farr
Director, Personnel and Training
Research Programs
Office of Naval Research
Arlington, VA 22217

1 Director
ONR Branch Office
495 Summer Street
Boston, MA 02210

1 Director
ONR Branch Office
1030 East Green Street
Pasadena, CA 91101

1 Director
ONR Branch Office
536 South Clark Street
Chicago, IL 60605

1 Office of Naval Research
Area Office
207 West 24th Street
New York, NY 10011

1 Commander
Operational Test and Evaluation
Force
U.S. Naval Base
Norfolk, VA 23511

6 Director
Naval Research Laboratory
Code 2627
Washington, DC 20390

12 Defense Documentation Center
Cameron Station, Building 5
5010 Duke Street
Alexandria, VA 22314

1 Chairman
Behavioral Science Department
Naval Command and Management
Division
U.S. Naval Academy
Luce Hall
Annapolis, MD 21402

1 Chief of Naval Technical Training
Naval Air Station Memphis (75)
Millington, TN 38054
ATTN: Dr. G.D. Mayo

1 Chief of Naval Training
Naval Air Station
Pensacola, FL 32508
ATTN: CAPT Allen E. McMichael

1 Chief
Bureau of Medicine and Surgery
Code 513
Washington, DC 20390

1 Chief
Bureau of Medicine and Surgery
Research Division (Code 713)
Department of the Navy
Washington, DC 20390

1 Commandant of the Marine Corps
(Code AO1M)
Washington, DC 20380

1 Commander Naval Air Reserve
Naval Air Station
Glenview, IL 60026

1 Commander
Naval Air Systems Command
Navy Department, AIR-413C
Washington, DC 20360

1 Commander
Submarine Development Group Two
Fleet Post Office
New York, NY 09501

1 Commanding Officer
Naval Air Technical Training Center
Jacksonville, FL 32213

1 Commanding Officer
Naval Medical Neuropsychiatric
Research Unit
San Diego, CA 92152

1 Commanding Officer
Naval Personnel and Training
Research Laboratory
San Diego, CA 92152

1 Commanding Officer
Service School Command
U.S. Naval Training Center
San Diego, CA 92133
ATTN: Code 303

1 Head, Personnel Measurement Staff
Capital Area Personnel Service
Office
Ballston Tower #2, Room 1204
801 N. Randolph Street
Arlington, VA 22203

1 Program Coordinator
Bureau of Medicine and Surgery
(Code 71G)
Department of the Navy
Washington, DC 20390

1 Research Director, Code 06
Research and Evaluation Department
U.S. Naval Examining Center
Building 2711 - Green Bay Area
Great Lakes, IL 60088
ATTN: C.S. Winiewicz

1 Superintendent
Naval Postgraduate School
Monterey, CA 93940
ATTN: Library (Code 2124)

1 Technical Director
Naval Personnel Research and
Development Laboratory
Washington Navy Yard
Building 200
Washington, DC 20390

1 Technical Director
Personnel Research Division
Bureau of Naval Personnel
Washington, DC 20370

1 Technical Library (Pers-11B)
Bureau of Naval Personnel
Department of the Navy
Washington, DC 20360

1 Technical Library
Naval Ship Systems Command
National Center
Building 3 Room 3
S-08
Washington, DC 20360

1 Technical Reference Library
Naval Medical Research Institute
National Naval Medical Center
Bethesda, MD 20014

1 COL George Caridakis
Director, Office of Manpower
Utilization
Headquarters, Marine Corps (A01H)
MCB
Quantico, VA 22134

1 Special Assistant for Research
and Studies
OASN (M&RA)
The Pentagon, Room 4E794
Washington, DC 20350

1 Mr. George N. Graine
Naval Ship Systems Command
(SHIPS 03H)
Department of the Navy
Washington, DC 20360

1 CDR Richard L. Martin, USN
COMFAIRMIRAMAR F-14
NAS Miramar, CA 92145

1 Mr. Lee Miller (AIR 413E)
Naval Air Systems Command
5600 Columbia Pike
Falls Church, VA 22042

1 Dr. James J. Regan
Code 55
Naval Training Device Center
Orlando, FL 32813

1 Dr. A.L. Slafkosky
Scientific Advisor (Code Ax)
Commandant of the Marine Corps
Washington, DC 20380

1 LCDR Charles J. Theisen, Jr., MSC, USN
CSOT
Naval Air Development Center
Warminster, PA 18974

1 Dr. Harold Booher
NAVAIR 415C
Naval Air Systems Command
5600 Columbia Pike
Falls Church, VA 22042

ARMY

1 Behavioral Sciences Devision
Office of Chief of Research and Development
Department of the Army
Washington, DC 20310

1 U.S. Army Behavior and Systems Research Laboratory
Rosslyn Commonwealth Building, Room 239
1300 Wilson Boulevard
Arlington, VA 22209

1 Director of Research
U.S. Army Armor Human Research Unit
ATTN: Library
Building 2422 Morade Street
Fort Knox, KY 40121

1 COMMANDANT
U.S. Army Adjutant General School
Fort Benjamin Harrison, IN 46216
ATTN: ATSAG-EA

1 Commanding Officer
ATTN: LTC Montgomery
USACDC-PASA
Ft. Benjamin Harrison, IN 46249

1 Director
Behavioral Sciences Laboratory
U.S. Army Research Institute of Environmental Medicine
Natick, MA 01760

1 Commandant
United States Army Infantry School
ATTN: ATSIN-H
Fort Benning, GA 319-5

1 U.S. Army Research Institute
Room 239
Commonwealth Building
1300 Wilson Boulevard
Arlington, VA 22209
ATTN: Dr. R. Dusek

1 Mr. Edmund Fuchs
BESRL
Commonwealth Building, Room 239
1320 Wilson Boulevard
Arlington, VA 22209

AIR FORCE

1 AFHRL (TR/Dr. G.A. Eckstrand)
Wright-Patterson Air Force Base
Ohio 45433

1 AFHRL/MD
701 Prince Street
Room 200
Alexandria, VA 22314

1 AFOSR (NR)
1400 Wilson Boulevard
Arlington, VA 22209

1 COMMANDANT
USAF School of Aerospace Medicine
ATTN: Aeromedical Library (SCL-4)
Brooks AFB, TX 78235

1 Personnel Research Division
AFHRL
Lackland Air Force Base
San Antonio, TX 78236

1 Headquarters, U.S. Air Force
Chief, Personnel Research and
Analysis Division (AF/DPXY)
Washington, DC 20330

1 Research and Analysis Division
AF/DPXYR Room 4C200
Washington, DC 20330

1 CAPT Jack Thorpe USAF
Dept. of Psychology
Bowling Green State University
Bowling Green, OH 43403

DOD

1 Mr. Joseph J. Cowan, Chief
Psychological Research Branch (P-1)
U.S. Coast Guard Headquarters
400 Seventh Street, SW
Washington, DC 20590

1 Dr. Ralph R. Canter
Director for Manpower Research
Office of Secretary of Defense
The Pentagon, Room 3C980
Washington, DC 20301

1 Dr. Charles Ullman
Chief of Counseling, Training
Programs
OSD(M&RA)
The Pentagon, Room 2C252
Washington, DC 20301

OTHER GOVERNMENT

1 Dr. Alvin E. Goins, Chief
Personality and Cognition
Research Section
Behavioral Sciences Research
Branch
National Institute of Mental Health
5600 Fishers Lane
Rockville, MD 20852

1 Dr. Lorraine D. Eyde
Bureau of Intergovernmental
Personnel Programs
Room 2519
U.S. Civil Service Commission
1900 E. Street, NW
Washington, DC 20415

1 Professor John Annett
The Open University
Waltonteale, BLETCHLEY
Bucks, ENGLAND

1 Dr. Richard C. Atkinson
Department of Psychology
Stanford University
Stanford, CA 94305

1 Dr. Kenneth E. Clark
University of Rochester
College of Arts and Sciences
River Campus Station
Rochester, NY 14627

1 Dr. Rene V. Davis
Department of Psychology
324 Elliott Hall
University of Minnesota
Minneapolis, MN 55455

1 Dr. Robert Dubin
Graduate School of Administration
University of California
Irvine, CA 92664

1 Dr. Marvin D. Dunnette
University of Minnesota
Department of Psychology
Elliott Hall
Minneapolis, MN 55455

1 ERIC
Processing and Reference Facility
4833 Rugby Avenue
Bethesda, MD 20014

1 Dr. Victor Fields
Department of Psychology
Montgomery College
Rockville, MD 20850

1 Mr. Paul P. Foley
Naval Personnel Research and
Development Laboratory
Washington Navy Yard
Washington, DC 20390

1 Dr. Robert Glaser
Learning Research and
Development Center
University of Pittsburgh
Pittsburgh, PA 15213

1 Dr. Albert S. Glickman
American Institutes for Research
8555 Sixteenth Street
Silver Spring, MD 20910

1 Dr. Richard S. Hatch
Decision Systems Associates, Inc.
11428 Rockville Pike
Rockville, MD 20852

1 Dr. M.D. Havron
Human Sciences Research, Inc.
Westgate Industrial Park
7710 Old Springhouse Road
McLean, VA 22101

1 Human Resources Research
Organization
Divison #3
Post Office Box 5787
Presidio of Monterey, CA 93940

1 Human Resources Research
Organization
Division #4, Infantry
Post Office Box 2086
Fort Benning, GA 31905

1 Human Resources Research
Organization
Division #5, Air Defense
Post Office Box 6057
Fort Bliss, TX 79916

1 Library
HumRRO Division Number 6
P.O. Box 428
Fort Rucker, AL 36360

1 Dr. Lawrence B. Johnson
Lawrence Johnson and Associates, Inc.
2001 "S" Street, NW
Suite 502
Washington, DC 20009

1 Dr. Norman J. Johnson
Associate Professor of Social Policy
School of Urban and Public Affairs
Carnegie-Mellon University
Pittsburgh, PA 15213

1 Dr. Roger A. Kaufman
Graduate School of Human Behavior
U.S. International University
8655 E. Pomerada Road
San Diego, California 92124

1 Dr. Frederick M. Lord
Educational Testing Service
Princeton, NJ 08540

1 Dr. E.J. McCormick
Department of Psychological Sciences
Purdue University
Lafayette, IN 47907

1 Dr. Robert R. Mackie
Human Factors Research, Inc.
Santa Barbara Research Park
6780 Cortona Drive
Goleta, CA 93017

1 Dr. Stanley M. Nealy
Department of Psychology
Colorado State University
Fort Collins, CO 80521

1 Mr. Luigi Petrullo
2431 North Edgewood Street
Arlington, VA 22207

1 Dr. Robert D. Pritchard
Assistant Professor of Psychology
Purdue University
Lafayette, IN 47907

1 Psychological Abstracts
American Psychological Association
1200 Seventeenth Street, NW
Washington, DC 20036

1 Dr. Diane M. Ramsey-Klee
R-K Research & System Design
3947 Ridgemont Drive
Malibu, CA 90265

1 Dr. Joseph W. Rigney
Behavioral Technology
Laboratories
University of Southern
California
3717 South Grand
Los Angeles, CA 90007

1 Dr. Leonard L. Rosenbaum, Chairman
Department of Psychology
Montgomery College
Rockville, MD 20850

1 Dr. George E. Rowland
Rowland and Company, Inc.
Post Office Box 61
Haddonfield, NJ 08033

1 Dr. Benjamin Schneider
Department of Psycholgoy
University of Maryland
College Park, MD 20742

1 Dr. Arthur I. Siegel
Applied Psychological Services
Science Center
404 East Lancaster Avenue
Wayne, PA 19087

1 Dr. David Weiss
University of Minnesota
Department of Psychology
Elliott Hall
Minneapolis, MN 55455

1 Mr. Edmond Marks
109 Grange Building
Pennsylvania State University
University Park, PA 16802

1 LCOL Austin W. Kibler, Director
Human Resources Research Office
ARPA
1400 Wilson Boulevard
Arlington, VA 22209

1 Century Research Corporation
4113 Lee Highway
Arlington, VA 22207

1 CAPT John F. Riley, USN
Commanding Officer
U.S. Naval Amphibious School
Coronado, CA 92155

1 Dr. Kenneth E. Young, Vice President
American College Testing Program
Suite 340
One DuPont Circle, N.W.
Washington, DC 20036

1 Mr. Emanuel P. Somer, Head
Motivational and Survey Research
Division
Psychological Research Department
Naval Personnel R&D Laboratory
Washington Navy Yard
Washington, DC 20374